Table S1. A) 230Th dating results from HOR and MO-1 samples (data from the University of Minnesota). Analytical errors are 2 of the mean. Samples in italics (red colour) are rejected (reversals) and samples with an asterisk (\*) were obtained from the twin stalagmite (see text).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cave** | **Sample** | **238U** | **[230Th/238U]** | **234U** | **[230Th/232Th]** | **Age** | **234Uinitial** | **230Th Age (yr BP)\*\*\*** |
|  | **ID** | **ppb** | **activity*c*** | **measured*a*** | **ppm*d*** | **corrected *c,e*** | **corrected** | **(corrected )** |  |
| Grutas de Cristal | *MO-1,1240* | *79.4* | *0.2150* | *±0.0008* | *273.8* | *±1.5* | *327.9* | *±6.7* | *19779* | *±193* | *290* | *±2* | *19719* | *±193* |
| Grutas de Cristal | MO-1,1183 | 61.3 | 0.0501 | ±0.0004 | 157.6 | ±1.5 | 258 | ±6 | 4736 | ±70 | 160 | ±2 | 4676 | ±70 |
| Grutas de Cristal | MO-1, 1105 | 58.1 | 0.0538 | ±0.0004 | 167.4 | ±1.5 | 287.7 | ±6.5 | 5065 | ±70 | 170 | ±1 | 5005 | ±70 |
| Grutas de Cristal | MO-1,1025 | 61.0 | 0.0592 | ±0.0005 | 153.4 | ±1.5 | 237.4 | ±5.3 | 5632 | ±88 | 156 | ±2 | 5572 | ±88 |
| Grutas de Cristal | *MO-1,947* | *151.5* | *0.0384* | *±0.0003* | *281.0* | *±1.7* | *774.4* | *±17.8* | *3300* | *±32* | *284* | *±2* | *3240* | *±32* |
| Grutas de Cristal | MO-1,910 | 70.8 | 0.0732 | ±0.0007 | 147.1 | ±2.9 | 729.0 | ±16.9 | 7143 | ±80 | 150 | ±3 | 7083 | ±80 |
| Grutas de Cristal | MO-1,885 (\*) | 97.1 | 0.0553 | ±0.0003 | 185.9 | ±1.8 | 101.3 | ±2.1 | 4977 | ±159 | 189 | ±2 | 4917 | ±159 |
| Grutas de Cristal | MO-1,870 | 128.1 | 0.0729 | ±0.0004 | 149.5 | ±1.5 | 496.6 | ±10.4 | 7075 | ±60 | 153 | ±1 | 7015 | ±60 |
| Grutas de Cristal | MO-1, 710 | 78.1 | 0.0873 | ±0.0004 | 144.4 | ±1.5 | 140 | ±3 | 8376 | ±191 | 148 | ±2 | 8316 | ±191 |
| Grutas de Cristal | *MO-1,435* | *105.6* | *0.1293* | *±0.0006* | *220.8* | *±1.5* | *210* | *±4* | *11930* | *±180* | *228* | *±2* | *11870* | *±180* |
| Grutas de Cristal | MO-1,425 | 191.0 | 0.1030 | ±0.0007 | 174.9 | ±4.1 | 84 | ±2 | 9483 | ±361 | 180 | ±4 | 9423 | ±361 |
| Grutas de Cristal | MO-1,360 (\*) | 117.2 | 0.0976 | ±0.0004 | 180.7 | ±1.7 | 842 | ±17 | 9340 | ±54 | 186 | ±2 | 9280 | ±54 |
| Grutas de Cristal | *MO-1,380* | *140.5* | *0.1297* | *±0.0021* | *203.0* | *±3.4* | *288* | *±7* | *12224* | *±252* | *210* | *±4* | *12164* | *±252* |
| Grutas de Cristal | MO-1,305 | 166.5 | 0.1011 | ±0.0006 | 180.1 | ±4.2 | 106 | ±2 | 9360 | ±281 | 185 | ±4 | 9300 | ±281 |
| Grutas de Cristal | *MO-1,290* | *169.7* | *0.1276* | *±0.0005* | *228.1* | *±1.9* | *193* | *±4* | *11663* | *±189* | *236* | *±2* | *11603* | *±189* |
| Grutas de Cristal | MO-1,240 | 128.0 | 0.1125 | ±0.0008 | 172.2 | ±2.4 | 41 | ±1 | 9859 | ±796 | 177 | ±3 | 9799 | ±796 |
| Grutas de Cristal | MO-1,200 | 154.6 | 0.0991 | ±0.0006 | 161.2 | ±1.7 | 227 | ±5 | 9528 | ±141 | 166 | ±2 | 9468 | ±141 |
| Grutas de Cristal | MO-1,125 | 104.8 | 0.1044 | ±0.0009 | 166.6 | ±1.5 | 137 | ±3 | 9892 | ±241 | 171 | ±2 | 9832 | ±241 |
| Grutas de Cristal | MO-1,75 | 81.1 | 0.1102 | ±0.0007 | 158.0 | ±2.4 | 61 | ±1 | 10128 | ±536 | 163 | ±2 | 10068 | ±536 |
| Grutas de Cristal | MO-1,7 | 138.2 | 0.1250 | ±0.0005 | 204.1 | ±1.5 | 118.6 | ±2.4 | 11495 | ±300 | 211 | ±2 | 11435 | ±300 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| El Recuenco | HOR-133.5 | 150.7 | 0.0274 | ±0.0002 | 81.5 | ±1.8 | 513 | ±11 | 2777 | ±27 | 82 | ±2 | 2715 | ±27 |
| El Recuenco | HOR-127.5 | 153.1 | 0.0290 | ±0.0003 | 73.0 | ±2.7 | 48 | ±1 | 2722 | ±192 | 74 | ±3 | 2659 | ±192 |
| El Recuenco | HOR-121 | 144.0 | 0.0297 | ±0.0002 | 68.8 | ±2.5 | 126 | ±3 | 2963 | ±79 | 69 | ±3 | 2900 | ±79 |
| El Recuenco | HOR-115 | 138.8 | 0.0318 | ±0.0004 | 65.4 | ±2.2 | 45 | ±1 | 2987 | ±227 | 66 | ±2 | 2924 | ±227 |
| El Recuenco | HOR-109 | 108.0 | 0.0342 | ±0.0003 | 81.4 | ±2.3 | 124 | ±3 | 3378 | ±93 | 82 | ±2 | 3315 | ±93 |
| El Recuenco | HOR-103 | 109.0 | 0.0349 | ±0.0004 | 73.9 | ±2.3 | 145 | ±3 | 3490 | ±85 | 75 | ±2 | 3427 | ±85 |
| El Recuenco | HOR 98 | 99.0 | 0.0363 | ±0.0004 | 73.0 | ±2.0 | 560 | ±13 | 3723 | ±48 | 74 | ±2 | 3661 | ±48 |
| El Recuenco | HOR-91 | 119.4 | 0.0363 | ±0.0005 | 73.9 | ±2.2 | 66 | ±2 | 3503 | ±182 | 75 | ±2 | 3440 | ±182 |
| El Recuenco | HOR-85 | 122.5 | 0.0397 | ±0.0005 | 78.9 | ±2.2 | 145 | ±3 | 3962 | ±99 | 80 | ±2 | 3899 | ±99 |
| El Recuenco | HOR-79 | 117.5 | 0.0401 | ±0.0004 | 69.0 | ±2.1 | 179 | ±4 | 4063 | ±81 | 70 | ±2 | 4000 | ±81 |
| El Recuenco | HOR-73 | 108.3 | 0.0415 | ±0.0003 | 74.3 | ±2.2 | 240 | ±5 | 4217 | ±65 | 75 | ±2 | 4154 | ±65 |
| El Recuenco | HOR-67 | 111.7 | 0.0434 | ±0.0004 | 68.9 | ±2.2 | 63 | ±1 | 4210 | ±224 | 70 | ±2 | 4147 | ±224 |
| El Recuenco | HOR 63.5 | 122.9 | 0.0434 | ±0.0003 | 76.2 | ±1.8 | 488 | ±14 | 4442 | ±46 | 77 | ±2 | 4380 | ±46 |
| El Recuenco | HOR-55 | 137.5 | 0.0455 | ±0.0003 | 63.9 | ±1.9 | 323 | ±7 | 4706 | ±53 | 65 | ±2 | 4643 | ±53 |
| El Recuenco | HOR-49 | 104.2 | 0.0498 | ±0.0003 | 87.4 | ±2.2 | 128 | ±3 | 4940 | ±127 | 89 | ±2 | 4877 | ±127 |
| El Recuenco | HOR-43 | 123.0 | 0.0503 | ±0.0003 | 83.9 | ±2.3 | 315 | ±7 | 5103 | ±59 | 85 | ±2 | 5040 | ±59 |
| El Recuenco | HOR-37 | 122.1 | 0.0521 | ±0.0005 | 85.0 | ±2.2 | 67 | ±1 | 5021 | ±250 | 86 | ±2 | 4958 | ±250 |
| *El Recuenco* | *HOR 35.5* | *112.1* | *0.0553* | *±0.0004* | *102.4* | *±1.8* | *967* | *±21* | *5581* | *±50* | *104* | *±2* | *5519* | *±50* |
| El Recuenco | HOR-25 | 133.8 | 0.0544 | ±0.0003 | 76.5 | ±2.0 | 139 | ±3 | 5481 | ±129 | 78 | ±2 | 5418 | ±129 |
| El Recuenco | HOR-19 | 134.6 | 0.0560 | ±0.0005 | 63.4 | ±3.4 | 259 | ±6 | 5798 | ±92 | 64 | ±3 | 5735 | ±92 |
| El Recuenco | HOR-13 | 114.1 | 0.0603 | ±0.0003 | 73.8 | ±2.2 | 126 | ±3 | 6090 | ±155 | 75 | ±2 | 6027 | ±155 |
| El Recuenco | HOR-7 | 127.4 | 0.0594 | ±0.0003 | 73.5 | ±1.8 | 330 | ±7 | 6126 | ±67 | 75 | ±2 | 6063 | ±67 |
| *El Recuenco* | *HOR-3.5* | *128.4* | *0.0975* | *±0.0004* | *102.6* | *±2.1* | *810* | *±17* | *10032* | *±58* | *106* | *±2* | *9970* | *±58* |
|  |
| *a*234U = ([234U/238U]activity - 1) x 1000.  |
| *b*234Uinitial corrected was calculated based on 230Th age (T), i.e., 234Uinitial = 234Umeasured *X* e234\*T, and T is corrected age. |
| *c*[230Th/238U]activity = 1 - e-230*T* + (234Umeasured/1000)[230/(230 - 234)](1 - e-(230 - 234) *T*), where *T* is the age. |
| Decay constants are 9.1577 x 10-6 yr-1 for 230Th, 2.8263 x 10-6 yr-1 for 234U, and 1.55125 x 10-10 yr-1 for 238U (Cheng et al., 2000). |
| *d* The degree of detrital 230Th contamination is indicated by the [230Th/232Th] atomic ratio instead of the activity ratio. |
| eAge corrections were calculated using an average crustal 230Th/232Th atomic ratio of 4.4 x 10-6 ± 2.2 x 10-6. |
| Those are the values for a material at secular equilibrium, with the crustal 232Th/238U value of 3.8. The errors are arbitrarily assumed to be 50%. |

Table S1. B) 230Th dating results from MO-7 stalagmite (data from the University of Melbourne).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cave** | **Sample** | **Lab ID** | **U ppb** | **[230Th/238U]a** | **[234U/238U]a** | **[232Th/238U]** | **[230Th/232Th]** | **Age(ka)b** | **[234U/238U]ic** |
|  |  |  |  |  |  |  |  |  |  |
| Grutas de Cristal | MO-7-747 | UMB03451 | n.a. | 0.0301(13) | 1.0118(37) | 0.00502(18) | 6.0 | 3.13(.23) | 1.0119(36) |
| Grutas de Cristal | MO7-715 | UMB03905 | 80 | 0.0313(08) | 1.0015(30) | 0.00131(01) | 23.8 | 3.42(.11) | 1.0015(32) |
| Grutas de Cristal | MO7-687 | UMB03904 | 70 | 0.0364(08) | 0.9935(30) | 0.00146(01) | 24.9 | 4.02(.09) | 0.9936(29) |
| Grutas de Cristal | MO7-657 | UMB03901 | 64 | 0.0536(14) | 0.9889(34) | 0.00141(04) | 38.2 | 6.03(.15) | 0.9886(34) |
| Grutas de Cristal | MO-7 600 | UMB03450 | n.a. | 0.0653(25) | 0.9688(47) | 0.00602(20) | 10.9 | 7.39(.37) | 0.9682(44) |
| Grutas de Cristal | MO-7 585 | UMB03488 | 43 | 0.0961(18) | 1.0019(35) | 0.01100(04) | 8.7 | 10.65(.39) | 1.0020(36) |
| Grutas de Cristal | MO7-573 | UMB03900 | 87 | 0.1169(19) | 1.0085(26) | 0.00117(01) | 100.1 | 13.42(.22) | 1.0089(28) |
|   |   |   |   |   |   |   |   |   |   |
|  |  |  |  |  |  |  |  |  |  |
| a Activity ratios determined after (Hellstrom, 2003) using the decay constants of (Cheng et al., 2000) |  |  |  |  |
| b Age in kyr before present corrected for initial 230Th using eqn. 1 of (Hellstrom, 2006) and [230Th/232Th]i of 0.9 ± 0.4 |  |  |  |
| c Initial [234U/238U] calculated using corrected age |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |